

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)

Applicant's or agent's file reference INT.1075MAJR	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/ZA 02/00211	International filing date (day/month/year) 17.12.2002	Priority date (day/month/year) 03.01.2002
International Patent Classification (IPC) or both national classification and IPC F42D3/04, F42D3/04		
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- This International preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 7 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 4 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 01.08.2003	Date of completion of this report 13.04.2004
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Giesen, M Telephone No. +31 70 340-3747 

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/ZA 02/00211**

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-21 as originally filed

Claims, Numbers

1-30 received on 01.08.2003 with letter of 30.07.2003

Drawings, Sheets

1/11-11/11 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

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5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-30
	No: Claims	
Inventive step (IS)	Yes: Claims	
	No: Claims	1-30
Industrial applicability (IA)	Yes: Claims	1-30
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. The application does not meet the requirement of clarity of Article 6 PCT.
 - 1.1 Although feature (d) of the independent claim 1 requires that the base of the cartridge be supported, which, according to the drawings appears to be done by resting the base 32 on the bottom of the hole, but is not elucidated in the independent claim, dependent claim 2 allows a spacing of the base 32 from the bottom of the hole.

Consequently this feature is not clear.

The applicant's argument, that in US 5 765 923 A (D1), the cartridge is spaced from the bottom of the hole, which should constitute a significant difference between D1 and the present application appears therefore not correct.

- 1.2 The independent claims 1 and 21 differ not only by category, but also in their subject matter, leading to unclarity due to contradiction between the claims.

Whereas in independent claim 21 a "relatively weaker region of the container ... at a junction between the wall and the base" is required as an essential feature, this feature is not presented in independent claim 1.

This essential feature should have been included in independent claim 1.

2. US 5 765 923 A (D1), in particular figures 3 and 9 - 12, as well as corresponding column 14, line 51 - column 15, line 32, describes a method for breaking rock including the steps of:
 - (a) loading at least a first cartridge into a hole in a rock face;
 - (b) confining the cartridge in the hole;
 - (c) initiating a propellant in the cartridge thereby causing the release of pressurised material;
 - (d) supporting a base of the cartridge to prevent the base from fracturing under the effect of the pressurised material; and
 - (f) directing the pressurised material at least to a periphery of the base to initiate breakage of rock adjacent the periphery.

As is evident from the comparison between figures 9/10 (before firing) and figures 11/12 (after firing), the base of the cartridge is severed off from the wall of the cartridge (as required by the features of independent claim 21 of the present application), but not fragmented/fractured, thereby deforming the pressure wave, which leads to the specific crack pattern, as indicated with reference numeral 111, in the surrounding regions of the hole.

3. The subject matter of amended independent claim 1 differs from this prior art by an additional method step (e) based on original dependent claims 5 and 6.

According to method step (e) the pressure wave is deformed by means of one or more wave deforming members on an inner or outer side of the cartridge to create at least one region inside the hole which has an increased stress concentration.

4. Consequently the problem to be solved by the present application can be formulated as: How can an increased stress concentration in at least one region inside the hole be created?

It is known to the man skilled in the art of breaking rock by means of pyrotechnic compositions, that an increased stress region can be created in a hole by means of deforming the pressure wave created by the pyrotechnic composition.

It is for example known in the art of rock breaking by means of pyrotechnic compositions, that a detonation wave resulting from the detonation of an explosive can be deformed by means of wave deforming members, as for example shown in general in SU 1 800 257 A (D2) or by means of focusing charges as shown in US 3 654 866 A (D3).

It is self-evident to the man skilled in said art, that if a detonation wave travelling at about the speed of sound can be deformed, a pressure wave travelling at sub-sonic speed, such as the pressure wave resulting from deflagration can also be deformed. In particular a deforming member as shown in D2 will function as well for a detonation wave as for a sub-sonic deflagration pressure wave. For the principle of the deformation of the pressure wave it is immaterial whether the propellant is placed within a cartridge or filled in the borehole.

Therefore the incorporation of method step (e) in the amended independent claim 1 does not require the exercise of inventive skills.

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5. Consequently the subject matter of present independent claim 1 does not involve an inventive step.

6. Dependent claims 2 - 20 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:

The features of dependent claims 2, 5 and 6 are known from or suggested by the combination of D1 and D2.

The features of dependent claims 3, 4, 7 and 13 are known from or suggested by SU 1 362 213 A (D4).

The features of dependent claims 8 - 12 are known from US 6 148 730 A (D5).

The features of dependent claims 13 - 20 are known from D3.

7. D1 furthermore describes an apparatus for breaking rock, which includes a first cartridge with a base (27) and a side wall which form an enclosure, and a propellant (30) inside the enclosure, and wherein a discontinuous relatively weaker section region (32) of the container is formed at a junction between the wall and the base.

The subject matter of amended independent device claim 21 differs from this prior art in the presence of a pressure wave deforming member.

The same reasoning as in points 2 - 4 above also applies to the subject matter of the amended independent device claim 21.

Consequently also the subject matter of independent claim 21 does not involve an inventive step.

8. Dependent claims 22 - 30 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step, the reasons being as follows:

The features of dependent claims 22 - 27 are known from or suggested by a combination of D1 and D2/D3.

The features of dependent claims 28 - 30 are known from or suggested by D5.

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9. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.
10. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

CLAIMS

1. A method of breaking rock which includes the steps of:
 - (a) loading at least a first cartridge into a hole in a rock face;
 - (b) ~~confining the cartridge in the hole;~~
 - 5 (c) initiating a propellant in the cartridge thereby to cause the release of pressurised material which generates a pressure wave inside the cartridge,
 - (d) supporting a base of the cartridge to prevent the base from fracturing under the effect of the pressurised material,
 - 10 (e) deforming the pressure wave by means of one or more wave deforming members on an inner or outer side of the cartridge to create at least one region inside the hole which has an increased stress concentration, and
 - (f) directing the pressurised material at least to a periphery of the base to initiate breakage of rock adjacent the periphery.
2. A method according to claim 1 wherein the cartridge is supported inside the hole at a
15 location which is spaced from the bottom of the hole.
3. A method according to claim 1 or 2 wherein the first cartridge is positioned at a first location at or near a bottom of the hole and a second cartridge is positioned at a second location in the hole which is spaced from the first location.
4. A method according to claim 3 which includes the steps of igniting propellant in the
20 respective cartridges thereby to cause the release of pressurised material inside each cartridge, and at each location directing force which is generated by the respective pressurised material onto a respective surface of a wall of the hole at or near a base of the respective cartridge.
5. A method according to any one of claims 1 to 4 wherein the pressure wave is also
25 deformed by suitably shaping a base or a side wall of the cartridge.
6. A method according to any one of claims 1 to 5 which includes the step of detonating a first high-explosive inside the hole to generate a localised explosive shock wave in the rock.
7. A method according to claim 6 wherein a second high-explosive is detonated a
30 predetermined time period after detonation of the first high-explosive.

8. A method according to any one of claims 1 to 5 which includes the step of generating a high pressure jet of a second material which has a density which is greater than the density of the pressurised material.
9. A method according to claim 8 wherein the high pressure jet of the second material is generated at one or more predetermined positions in the cartridge.
10. A method according to claim 8 or 9 wherein the high pressure jet of the second material is generated by the action of the pressurised material, released in step (c), on at least one member which includes the second material.
11. A method according to any one of claims 8 to 10 wherein the high pressure jet of the second material is generated by the action of an explosive on at least one member which includes the second material.
12. A method according to claim 11 wherein the explosive is detonated by control means.
13. A method according to claim 1 wherein the propellant is initiated at a first predetermined time at least at a first zone and which includes the step at a second predetermined time of carrying out at least one of:
 - (i) detonating an explosive in the hole, and
 - (ii) initiating the propellant at least at a second zone in the hole.
14. A method according to claim 13 wherein the explosive is inside the cartridge or on an outer side of the cartridge.
15. A method according to claim 13 or 14 wherein the propellant and the explosive are initiated and detonated, respectively, by means of respective control signals which are transmitted from a control unit or units via control lines or by using wireless techniques.
16. A method according to claim 1 wherein the propellant creates a first pressure wave and which includes the steps of creating a second pressure wave and allowing the pressure waves to interfere with each other at a predetermined region.
17. A method according to claim 16 wherein the pressure waves are generated by initiating the propellant at two respective points which are spaced from each other.
18. A method according to claim 1 wherein in step (c) the propellant is initiated at least at first and second points which are spaced from each other in the cartridge, thereby to

generate at two wave fronts which are caused to interact with each other, each wave front causing the release of pressurised material.

19. A method according to claim 18 wherein the cartridge is elongate and the first and second points are located respectively at opposed ends of the cartridge.

5 20. A method according to claim 1 which includes the steps of loading a second cartridge into the hole and initiating the propellant in the first cartridge and a propellant in the second cartridge at respective first and second points thereby to cause the generation of pressure waves which are allowed to interact with each other at a location which is between the first and second points.

10 21. Apparatus for breaking rock which includes a first cartridge with a base and a side wall which form an enclosure, a propellant inside the enclosure, wherein a discontinuous relatively weaker region of the container is formed at a junction between the wall and the base, and at least one pressure wave deforming member which is exposed to a pressure wave generated by initiating the propellant and which
15 is selected from the following: at least one suitably shaped member inside or outside the cartridge; at least one suitably shaped member inside the propellant positioned at a desired distance relatively to the base.

20 22. Apparatus according to claim 21 wherein the cartridge is shaped to direct a wave of pressurised material, produced by the propellant when initiated, towards a periphery of the base.

23. Apparatus according to claim 21 or 22 which includes at least one high-explosive charge on or inside the cartridge.

24. Apparatus according to any one of claims 21 to 23 wherein the cartridge is made from a plastically deformable material.

25 25. Apparatus according to any one of claims 21 to 24 which includes at least one member, which is made from a material which has a density greater than the density of the propellant, on or inside the cartridge.

26. Apparatus according to claim 25 wherein the member is turned into a high pressure jet by the action of the propellant when it is ignited.

30 27. Apparatus according to claim 25 or 26 wherein an explosive which acts directly on the member is used to generate a high pressure jet of the material.

28. Apparatus according to any one of claims 21 to 27 which includes an explosive, and a control unit which initiates the propellant at a first predetermined time and which detonates the explosive at a second predetermined time.
29. Apparatus according to any one of claims 21 to 28 which includes at least first and second initiators for initiating the propellant at respective first and second points which are spaced from each other inside the cartridge.
30. Apparatus according to any one of claims 21 to 28 which includes a second cartridge which forms an enclosure for a propellant, each cartridge including a respective initiator for initiating the propellant in the respective enclosure, and wherein the cartridges are positioned in an assembly with the initiators at opposed remote points in the assembly.